IDCases 40 (2025) e02240

Contents lists available at ScienceDirect

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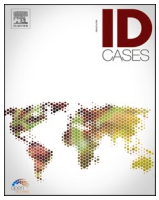

Case Report

Capnocytophaga cynodegmi bacteremia associated with a cat bite in a patient with systemic lupus erythematosus on hemodialysis: A case report

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ARTICLE INFO

Keywords:
Capnocytophaga cynodegmi
bacteremia
cellulitis
Cat Bite
MALDI-TOF MS
16S rRNA gene sequencing

ABSTRACT

The genus *Capnocytophaga*, which is part of the oral microbiome of both humans and animals, has the potential to cause severe infections in humans following animal bites. A 59-year-old man with systemic lupus erythematosus (SLE) on hemodialysis presented with cellulitis of the left upper limb after being bitten by his cat and was admitted to our hospital. Blood cultures were obtained, and empiric treatment with ampicillin/sulbactam was initiated. The patient developed a non-severe drug eruption on the 3rd hospital day, prompting a switch to ceftriaxone. Thin spindle-shaped Gram-negative bacilli were isolated from the blood cultures 127 h (5 days and 7 h) after obtained blood sample, and the patient completed a 2-weeks course of ceftriaxone with complete recovery. The isolate was identified as *Capnocytophaga cynodegmi* by MALDI-TOF MS and 16S rRNA gene sequencing. This case highlights the importance of considering *C. cynodegmi* in cat bite-associated infections. Obtaining blood cultures and extending incubation periods may be crucial for identifying the causative pathogen and guiding appropriate treatment in such cases.

Introduction

The genus *Capnocytophaga* is a group of fastidious gram-negative bacteria belonging to the family of *Flavobacteriaceae* [1]. Four *Capnocytophaga* species have been isolated from the canine oral cavity. Among these, *C. canimorsus* and *C. cynodegmi* are more predominant than *C. canis* and *C. stomatis* [2]. *C. canimorsus* and *C. cynodegmi* normally reside in the mouth of cats and dogs but can be transmitted to humans via bites and scratches [3]. Previous reports have documented that *C. canimorsus* can cause wound infections and disseminated infections leading to sepsis, meningitis, and endocarditis with a high mortality [4, 5]. Whereas, *C. cynodegmi* has been mainly detected in wound infections but systemic infection is very rare [3,4]. We describe a case of invasive infection caused by *C. cynodegmi* after cat had bitten.

Case report

A 59-year-old man was hospitalized with a 72-hour history of fever and painful left upper limb with swelling since his cat had bitten his left metacarpophalangeal (MP) joint. The swelling area had erythema, heat, and tenderness. It increased and extended to the left elbow on the day of admission.

He had a history of systemic lupus erythematosus (SLE) and antiphospholipid antibody syndrome (APS), for which he was being treated with prednisolone 15 mg/day. Additionally, he was on hemodialysis due to decreased renal function caused by lupus nephritis.

On admission, his blood pressure was 164/118 mmHg, pulse rate was 105 beats/minute, respiratory rate was 16 breaths/minute, and temperature was 37.1℃. At the time, he felt mild pain and tenderness in the left hand, forearm and the lower third of the upper arm (Fig. 1). We discovered wounds on the back of his left hand, displaying clear teeth indentations, and attributed to a cat bite (Fig. 2).

Abbreviations: PCR, Polymerase Chain Reaction; SLE, Systemic Lupus Erythematosus; APS, Antiphospholipid Antibody Syndrome; HTIG, human tetanus immunoglobulin; MALDI-TOF MS, Matrix-assisted laser desorption ionization time-of-flight mass spectrometry; 16S rRNA, 16S ribosomal ribonucleic acid.

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https://doi.org/10.1016/j.idcr.2025.e02240
Received 6 March 2025; Received in revised form 19 April 2025; Accepted 28 April 2025
Available online 29 April 2025

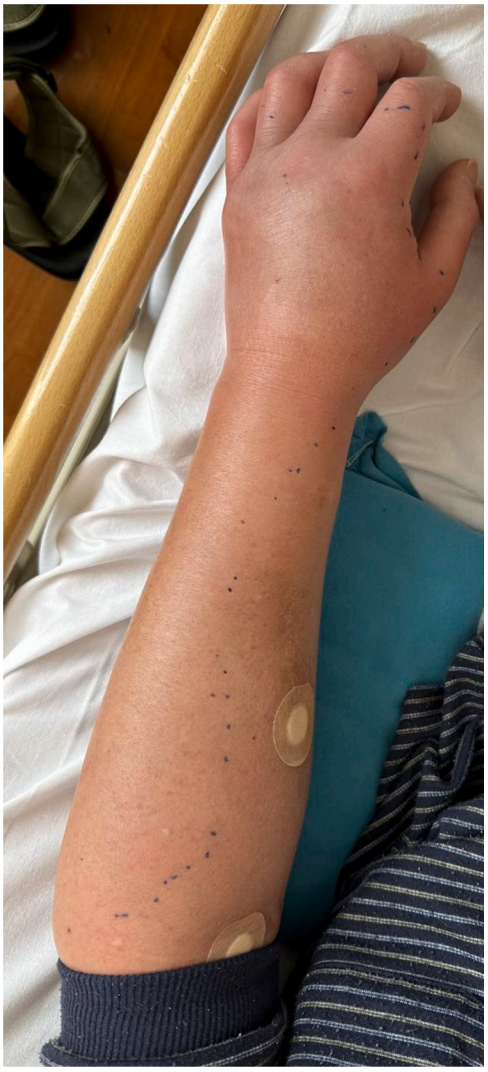

Fig. 1. The swelling area has erythema, heat, and tenderness in the left hand, forearm, and the lower third of the upper arm.

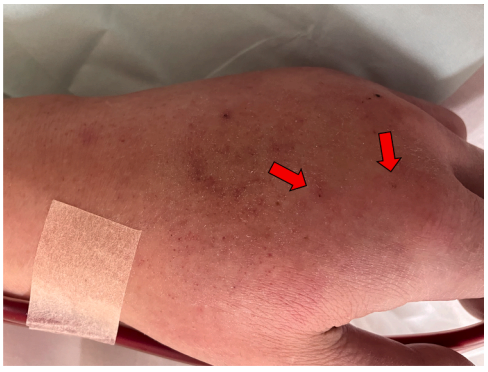

Fig. 2. The bite wounds on the back of his left hand, displaying clear teeth indentations (red arrows).

Laboratory results showed increased white blood cell count (16,800/μL [normal range, 3300–8600/μL]) and decreased platelet count (4.4×10^4/μL [normal range, $15.8–34.8 \times 10^4$/μL]). We suspected him to have acute cellulitis over left upper limb and assumed *Pasteurella multocida* as pathogen based on the history of cat bites. Therefore, we started to administer ampicillin / sulbactam 3 g every 24 h after obtaining two sets of blood cultures. In addition, he received 250 units of human tetanus immunoglobulin (HTIG) and the tetanus toxoid vaccine. On the 3rd hospital day, the erythema with pruritus appeared on the back which showed gradually onset and with no mucocutaneous rash. We diagnosed the skin rash with non-severe and non-type I drug eruption due to ampicillin / sulbactam and changed to ceftriaxone. On the 6th hospital day, his symptoms and drug eruption tended to improve. We scheduled to discharge him on the next day, but gram-negative bacillus was isolated in the blood culture taken on admission. The gram stain showed thin spindle-shaped Gram-negative rods (Fig. 3), and we suspected *Capnocytophaga* species rather than *Pasteurella* species. In particular, *C. canimorsus* infection was suspected, thus the patient continued to be hospitalized and treated with ceftriaxone for a total of 2 weeks. After treatment had done, he completely recovered.

MALDI-TOF MS (MALDI Biotyper; Bruker Daltonics, Billerica, MA, USA) identified the isolate as *Capnocytophaga* species with an identification score of 1.81. Furthermore, the 1,326-bp 16S ribosomal ribonucleic acid (RNA) gene sequence analysis revealed 99.17 % similarity with *Capnocytophaga cynodegmi* strain DSM 19736, 97.64 % with *Capnocytophaga canimorsus* strain ATCC 35979, and 97.50 % with *Capnocytophaga felis* KC07070. Since the isolate showed greater than 99 % similarity only with *C. cynodegmi*, and less than 99 % similarity with all other candidate species, we concluded that the isolate was *C. cynodegmi*.

Due to poor bacterial growth, antimicrobial susceptibility testing could not be performed.

Discussion

The primary pathogen within the genus *Capnocytophaga* is *Capnocytophaga canimorsus*, and several reports and studies have described its epidemiological characteristics. In a review by Butler, 484 cases of *C. canimorsus* infection were documented, including 192 cases before 1990 and 292 cases after 1990 [6]. Among these, detailed clinical data were available for 252 cases, consisting of 222 cases of bacteremia with positive blood cultures, 32 cases of meningitis, 12 cases of infective endocarditis (with positive blood cultures), 5 cases of wound infection, 6 cases of eye infection, and 5 cases of other infections. Of these 252 cases, underlying conditions included 59 cases of post-splenectomy, 10 cases of hyposplenism, 54 cases of alcohol abuse, and 129 cases without the aforementioned underlying conditions. In post-splenectomy patients, the median time from splenectomy to infection was 8 years (range: 8 months to 52 years), with a median age of 52 years, which was younger than other groups with underlying conditions. The mortality rate was 29 % (16 deaths). In the alcohol abuse group, the median age was 54 years, with a mortality rate of 29 % (15 deaths). Regarding animal exposure, clear documentation was available for 280 cases, including 165 cases of dog bites, 68 cases of non-bite dog contact (scratches, licking, or other contact), and 9 cases of cat contact.

Generally, we tend to associate *Capnocytophaga* species infections with dog bite wounds, and *Pasteurella* species infections with cat bite wounds. However, prior some cases reported that *Capnocytophaga* species can also be isolated from cat bite wounds and cause infections [7,8]. The report from Japan showed that *C. canimorsus* was detected in 74 % of dogs and 57 % of cats, *C. cynodegmi* was detected in 86 % of dogs and 84 % of cats. In the report, both bacterial species were detected together in 67 % of dogs and 56 % of cats [9]. *Capnocytophaga* species infections can occur by cat bites, and in such cases, *C. cynodegmi* may be the causative pathogen. However, documented cases of *C. cynodegmi* are limited.

So far, a total of four cases of *C. cynodegmi* infection have been reported: two cases of bacteremia following dog bites [10,11], and two cat-related infections comprising one cat bite wound infection [12] and one peritonitis in a peritoneal dialysis patient [13](Table 1). To the best of our knowledge, this is the first detailed report describing the clinical course of *C. cynodegmi* bacteremia associated with cats. Two cases of *C. cynodegmi* bacteremia caused by dog bites were reported: one was a

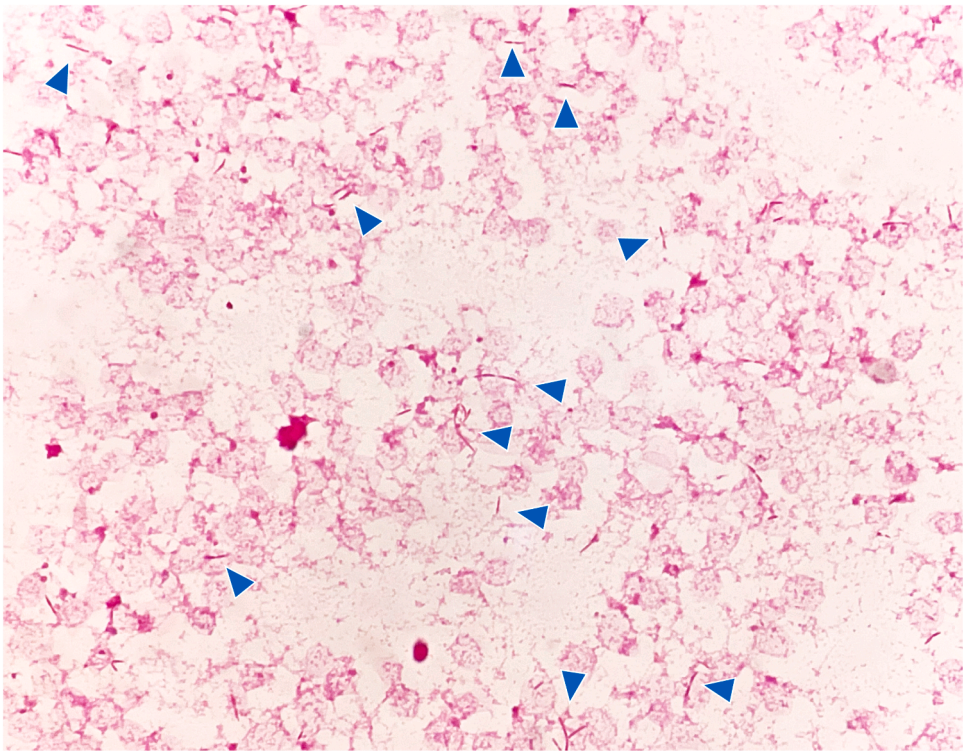

Fig. 3. Blood culture smears with gram staining showing thin spindle-shaped gram-negative rod bacillus (blue arrows).

Table 1
Literature review of previously reported cases of *Capnocytophaga cynodegmi* infection.

Age	Gender	Underlying medical conditions	Specimens obtained	Clinical feature/ Primary focus	Animal episode	Number of blood culture bottles	Time to blood culture positivity	Therapeutic agents	Clinical outcome	Reference
72	F	Diabetes mellitus, Traumatic splenectomy	Blood, cerebrospinal fluid	Bacteremia and Menigitis	Dog bite	Not reported	Not reported	Ceftriaxone	fatal	Khawari AA et al. [9]
59	M	Diabetes mellitus	Blood, Bronchoalveolar lavage fluid, Sputum, Wound	Cellulitis, Bacteremia, and Pneumonitis	Dog bite	Not reported	3days	Penicillin, Ciprofloxacin, Gentamicin, and Metronidazole	recovered	Sarma PS and Mohanty S [10]
63	F	Rheumatoid arthritis (TNF-α inhibitor, prednisone 7.5 mg daily)	Wound	Wound	Cat bite	Not reported	Not reported	Clarithromycin	recovered	Gerster JC and Dudler J [11]
67	M	End-stage kidney disiease due to hypertensive nephrosclerosis treated with peritoneal dialysis	Peritoneal fluid	Peritonitis in a peritoneal dialysis patient	Contact with neighbor's cat	Not reported	Not reported	Cefuroxime, Gentamicin, and Metronidazole	recovered	Pers C et al.[13]

TNF-α inhibitor, tumor necrosis factor-α inhibitor.

patient with diabetes mellitus and a history of traumatic splenectomy, and another was a patient with non-insulin-dependent diabetes mellitus [10,11]. Among patients with *C. cynodegmi* infection, only one patient had a history of splenectomy, and none had a documented history of alcohol abuse.

At our institution, we conducted a retrospective review of *Capnocytophaga* species infections over the past 10 years, identifying 10 cases involving various *Capnocytophaga* species (Table 2). Consistent with prior reports [14], two species known as zoonotic pathogens, *C. canimorsus* and *C. cynodegmi*, were associated with animal contact. The other species known as part of the human oral flora showed less association with animal contact.

Regarding underlying conditions, our cases demonstrated considerable diversity. None of our cases had a history of splenectomy or alcohol abuse, which are frequently reported risk factors in *C. canimorsus* infections.

In this case, the patient's underlying disease likely contributed to the development and progression of the infection. He had been receiving prednisolone at a dose of 15 mg/day for the treatment of systemic lupus erythematosus (SLE). Corticosteroid therapy is known to impair humoral and cellular immunity as well as neutrophil function [15], and SLE itself can lead to impaired humoral immunity [16]. This immunocompromised state may have increased the patient's susceptibility to infection with encapsulated bacteria such as *Capnocytophaga* species. As a result, the cat bite may have led not only to a localized wound infection but also to cellulitis and ultimately bacteremia.

Table 2
Cases of infections caused by *Capnocytophaga* species at our hospital in the past 10 years.

Patient	Age [year]	Gender	Underlying medical conditions	Species	Specimens obtained	Clinical feature/ Primary focus	Animal episode	Number of blood culture bottles	Time to blood culture positivity [hour]	Therapeutic agents	Clinical outcome
1	77	F	severeAS severeMR s/p AVR+MVR+TAP	C. leadbetteri	Blood	Bacteremia, CRBSIs/o	unknown	1/2 sets (aerobic bottle)	48 h	Vancomycin, Cefepime, and Ciprofloxacin	fatal
2	55	F	Multiple Myeloma	C. ochracea	Blood	Bacteremia	unknown	1/2 sets (aerobic bottle)	168 h	Ceftriaxone	recovered
3	40	M	No underlying conditions	C. canimorsus	Blood	Bacteremia	Dog bite	2/2 sets (all four bottles)	18 h	Ceftriaxone	recovered
4	68	M	Atrial fibrillation, Hypertension	C. canimorsus	Blood	Bacteremia, Cellulitis	Dog bite	2/2 sets (all four bottles)	50 h	Amoxicillin/ Clavulanate, Ciprofloxacin	recovered
5	20	F	Lemierre syndrome	C. sputigena	Pleural fluid	Empyema	negative	not applicable	not applicable	Ampicillin/Sulbactam	recovered
6	38	F	SLE/APS(PSL15mg MMF Belimumab)	C. sputigena	Sputum	Pneumonia	unknown	N/A	N/A	Ceftriaxone	recovered
7	69	M	OMI/TVD s/p CABG	C. sputigena	Sputum	Pneumonia	unknown	N/A	N/A	Piperacillin/ Tazobactam	recovered
8 (the present case)	59	M	SLE/APS ESKD on HD	C. cynodegmi	Blood	Bacteremia, Cellulitis	Cat bite	1/2 sets (aerobic bottle)	127 h	Ceftriaxone	recovered
9	91	M	Cronic Heart Failure	C. sputigena	Blood	Bacteremia	Cat contact	1/2 sets (aerobic bottle)	98 h	Ampicillin/Sulbactam	recovered
10	79	M	Hypertrophic cardiomyopathy, Diabetis mellitis, Rheumatoid arthritis	C. canimorsus	Blood	Bacteremia	Dog contact	1/2 sets (anaerobic bottle)	46 h	Ceftazidime	recovered

AS, aortic stenosis; MR, mitral regurgitation; AVR, aortic valve replacement; MVR, mitral valve replacement; TAP, tricuspid annuloplasty; SLE, systemic lupus erythematosus; APS, antiphospholipid syndrome; ESKD on HD, end-stage kidney disease on hemodialysis; CRBSI, catheter-related bloodstream infection; OMI, old myocardial infarction; TVD, triple vessel disease; CABG, coronary artery bypass grafting; MMF, mycophenolate mofetil; N/A, not applicable.

All *C. cynodegmi* bacteremia cases, including our case, were associated with direct contact with cats or dogs. When dealing with cases of skin and soft tissue infections, physicians should be diligent in eliciting information about a patient's history of animal exposure. Furthermore, in patients with a history of cat exposure, not only *Pasteurella* species but also *Capnocytophaga* species should be considered as potential causative agents of infection. In this case, *C. cynodegmi* was identified as the causative pathogen because blood cultures were obtained, even though the clinical presentation was a cat bite-induced cellulitis. Aiming to identify the pathogenic microorganism, we suggest proactively obtaining blood cultures in patients with animal bite-induced cellulitis, particularly those at risk for severe disease progression. A review of *C. canimorsus* reported that since the bacteria is slow-growing, blood cultures may require an incubation period of up to 14 days (with an average of 6 days) [17]. In our case, gram-negative bacillus was isolated in the blood culture 127 hours (5 days and 7 hours) after it was taken. It seems that for *C. cynodegmi*, similar to *C. canimorsus*, if an infection is suspected, it is necessary to extend the duration of blood culture incubation. U.S. guidelines for blood cultures recommend that culturing can be stopped after a 5-day period, as normal bacteria typically grow within this period [18].

However, in medical institutions where blood cultures are terminated after a 5-day period, there is a possibility that the culturing process may end before *Capnocytophaga* species can grow, potentially failing to detect bacteremia. At our institution, blood cultures are routinely incubated for 7 days to avoid missing fastidious organisms. Considering the time required for blood cultures to become positive in the previously reported review of 60 cases of *Capnocytophaga canimorsus* infection, there is concern that the standard 7-day incubation period used at our institution may be insufficient to detect *Capnocytophaga* species, potentially leading to false-negative culture results. The limited number of reporting *C. cynodegmi* bacteremia may be attributed to insufficient culture duration, which could lead to cases being overlooked. Therefore, especially for patients with animal bites, it is advisable to extend the culture period to at least 14 days.

Following the discussion on culture duration, treatment considerations should also be addressed. Antimicrobial therapy remains the primary treatment modality for infections caused by *Capnocytophaga* species. In select cases, surgical debridement serves as a critical complementary intervention. Evidence from a comprehensive systematic review of 128 patients with *C. canimorsus* infection demonstrates that early wound cleansing and surgical removal of the infectious focus significantly improves survival rates [19]. In our case, the wound was not heavily contaminated, and no surgical intervention was required beyond antimicrobial therapy.

Standardized guidelines for antimicrobial susceptibility testing of *Capnocytophaga* species are unavailable, and clinical data remain limited. Among the human oral–associated *Capnocytophaga* species, particularly *C. sputigena* and *C. ochracea*, β-lactamase production has been reported, potentially conferring resistance to third-generation cephalosporins and β-lactam/β-lactamase inhibitor combinations [20].

Meanwhile, infections caused by zoonotic *Capnocytophaga* species—namely *C. canimorsus* and *C. cynodegmi*—are typically treated with penicillin or penicillin combined with a β-lactamase inhibitor. This recommendation is based on historical susceptibility patterns, as these organisms have generally demonstrated broad-spectrum susceptibility. Given the potential involvement of *Capnocytophaga* species, *Pasteurella* species, and other oral anaerobes in dog and cat bite wounds, initial empirical therapy is typically initiated with β-lactam/β-lactamase inhibitor combinations, such as amoxicillin-clavulanate or ampicillin-sulbactam. In the present case, treatment was also initiated with ampicillin-sulbactam.

This case emphasizes the need to consider *Capnocytophaga* species in the differential diagnosis of infections following both dog and cat bites, and highlights the importance of extending blood culture incubation periods when these organisms are suspected.

CRediT authorship contribution statement

Yamamoto Takeru: Supervision. **Zhiren Wang:** Supervision. **Osawa Ryosuke:** Supervision. **Watanabe Naoki:** Writing – review & editing, Supervision, Data curation, Conceptualization. **Otsuka Yoshihito:** Supervision. **Hosokawa Naoto:** Writing – review & editing, Supervision, Conceptualization. **Ebisu Yosuke:** Supervision. **Nakao Masahiko:** Writing – review & editing, Writing – original draft, Project administration, Investigation, Data curation, Conceptualization. **Watari Tomohisa:** Supervision.

ICMJE Statement

Masahiko Nakao was responsible for the conception and design of the case report. All authors contributed to revising it critically for important intellectual content and the writing of the final manuscript.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

None

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